Inter-operative Learning and Research with Quality Management: a Categorization

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***Abstract* —** New types of action, integration and collaboration are required in higher education for the creation of innovation in services, technology, the economy and society. The objective of Integrative Action is to continuously integrate and actualize the three statutory tasks of the Finnish universities of applied sciences: education; research and development; and regional development. This study addresses the issue of design research for the utilization of action research and quality management systems (within an Integrative Action framework from the perspectives of research; education and development). The objective of this study is to describe categories of: analysis; interaction; learning; research; results; and the quality of the actualization that work as an inter-operational spine for the research framework of participatory and co-creative research between universities of applied sciences, national clusters and innovation systems. And also to use the categories as a case study sample of the research types within the higher education studies of information systems at Laurea.

***Keywords* —** action research, categorization, design research, theory, methodology, networked expertise, quality management.

I. Introduction

GENRALLY, there are three statutory tasks for Finnish universities of applied sciences, these are: education, research and development, and regional development. A design research (DR) and action research (AR) scope for universities of applied sciences is how to design, integrate and implement these three statutory tasks into everyday action. This study describes the implemented research processes of collaborative and Integrative Action research and design science research that have been combined with a quality framework from the perspective of action and learning processes. The process concepts and models were tested and integrated into education, research and development work in authentic cases between 2003 and 2009. This study focuses on Integrative Action, its research and quality processes, and its impact on the development work accomplished through operations in universities of applied sciences.

The tasks of the universities of applied sciences described in Finnish law [62] include: further and higher education that is responsive to working life and its developmental needs. These tasks are based on research and creative principles, as well as applied research and developmental work aimed at fostering regional development while taking into account the structure of an area and providing support for individual professional growth. Thus, universities of applied sciences are closely involved in authentic work life projects and cooperate with regional actors.

The pedagogical base of actualization is Learning by Developing (LbD) [13], [41] and [46]. It is an innovative operating culture which requires students to undertake projects rooted in the world of work and aims to produce new practices and competences. Progress in that requires collaboration between teachers, students and experts from commercial and state run enterprises. LbD may also be described as a learning vehicle for the development of two sets of competences. The first being generic competences such as work or life knowledge and skills, the second being subject specific competences [22] and [60].

From the perspective of learning, an action bridges knowledge and competence in Integrative Action processes. Such action is reasonable for competences that are emphasized in innovation systems [22] and [35]. LbD contributes to regional development by providing student interaction in state and commercial projects, and especially through Laurea creating international links and cooperation.

The metaphor of integrative actualization is that an "inter-operative campus should act like a magnet", improve the competitiveness of participants, and the wellbeing and competitiveness of regions, cities and society.

LbD provides a conceptual and tested framework and model for *inter-operative* learning that includes creativity as a value (added value or lost value) in collaboration with networks or individual organisations [40] and [36]. In this case the term inter-operative emphasizes: ability; interoperability; agility; trust; and value in collaboration. It also has a thematic nature e.g. thematic region, thematic living-labs, thematic curriculum and the thematic actualization of study courses.

The process model is the general Integrative Action and research model and its first contribution was the creation of a linear development framework for cyclic innovation activities with a quality perspective, it has been further developed for the implementation process of the three statutory tasks: education, research and development and regional development. The implemented Integrative Action has helped development, co-creation and co-operation between institutes of higher education and regions. Various versions of the Integrative Action process are presented in [32], [33] and [37].

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II. Research Setting

The research interest of this study is to categorize and describe the actualization of LbD and Integrative Action for: a) the building and evaluation of new information systems as new socio-technical artifacts within LbD culture and the further actualization of the three tasks; b) the improving of action, quality and evaluation interventions; c) the transferal of LbD and knowledge to other situations; d) co-operation with other universities, innovation systems and global actors; e) the future work of theorizing LbD and Integrative Action into a new Theory of Inter-operative Learning; and f) reducing diversity and ambiguousness in the LbD framework.

A. First Research Question

What are categories and dimensions of Integrative Action and LbD? In particular, what is the theoretical background and how it should be categorized? Why is LbD dimensional but not categorical? What are the categories and elements in Integrative Action?

B. Second Research Question

What similar categories should be included in research within studies of information systems, networks and security? In particular what similar categories influence in cases of DR and AR within Integrative Action? (Five learning cases are presented below.)

C. Challenges in the Actualization of Quality Management

The quality management in Integrative Action and LbD is based on the major quality frameworks: EFQM Excellence Model (Brussels, EFQM) [66]; ISO/DIS 9000: International Organization for Standardization [69]; and the BQF: British Quality Foundation [63]. These frameworks are experienced as large and complicated in everyday practice and more "user friendly" forms are needed.

D. Third Research Question

What should a user friendly quality framework with categories of quality actualization, which can be linked to major quality frameworks and willingly used in everyday inter-operative practice, be like?

E. Fourth General Question

What type of practical cases should be used to determine the research categories and the results that influence the categories, inter-operative learning and quality management?

F. Definition of term Category

The term category is a class or division of things regarded as having particular shared characteristics [72]. In this research the various categories address the actualization of the three statutory tasks and analysis is based on empirical action and material collected for the evaluation transactions of Laurea conducted by the Finnish Higher Education Evaluation Council (FINHEEC) 2003-2009 [50], [51], [60], [32] and [35].

III. Categorization and Analysis

The "unit of evaluation" has been "evidence" or "samples of evidence" in the evaluation transactions of FINHEEC during the time of this research scope 2003-2009. Hence, in this analysis the sampling unit is "practical evidence", and the unit of analysis should also be the evidence or "samples of evidence". Evidence is termed as an available body of facts or information indicating whether a belief or proposition is valid [72].

The used general categorization method is based on [7] and [49] where the conceptual categories (open categories) for qualitative analysis are generated. The material e.g. documents, transcripts and databases are analysed using open coding. The relational results and development targets (axial categories) are then composed and the data is analysed by use of selective coding. The analysis of data for the concepts and for information systems combines the fundamental bases of the grounded theory approach [7] (illustrated in left hand side of Fig.1) with the technique used to model data from the field of systems analysis in an information system's design research [5] and [57] (illustrated on the right hand side of Fig. 1).

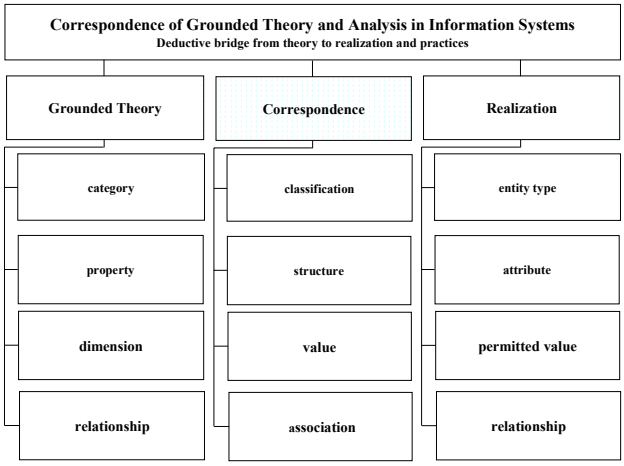

Fig. 1 There is strong correspondence [6] between these two sets of concepts: the grounded theory approach and the entity-relationship diagramming technique. This approach is a useful addition to the grounded theory scientist's toolkit when carrying out research using the grounded theory approach, especially in the building and empirical evaluation of results, relations and structures.

The categorization of the data concept for information systems uses a method based on an evolution type of development where concepts are in continuous dialogue with empirical data and practice. Since concepts are ways of summarizing data it is important that practice is able to adapt to the data that is going to be summarized into categories. This continuously running "taxonomy of data" connects a categorization work to the evolution based development work, from theory to practice (deductive).

The method is that the implementation of a diagram helps create a database for the results of the grounded theory categories and approach (theory testing). The definition and corresponding terms are detailed in [7] and [5].

IV. Background

A. Pedagogical Background

Yrjö Engeström studied innovative learning cycles in teams by using the cultural-historical activity theory and the theory of expansive learning as frameworks for analysis. He emphasized the knowledge-creation phase, where problems are first formulated and analyzed, and in which expansive and innovative learning begins by criticizing, questioning and analyzing existing practices. The focus is on dialectical tensions and contradictions within collective activities, although these are usually ignored by approaches that focus on immediate empirical generalizations. The model is understood through the analysis of elements found in an expansive learning cycle, as innovative learning cycles do not follow any fixed order. The arguments for this method are described in [11].

Kai Hakkarainen explained the progressive inquiry process with its characteristic autonomy and self-regulation of learning processes. The progressive inquiry process utilizes diversity and "creative chaos" rather than pre-structured and strictly controlled instructional processes, which do not have any degree of freedom. The model captures certain essential aspects of a knowledge creation process, such as the importance of questions and problems, deliberately working for knowledge advancement, engagement in a deepening inquiry, and the socially shared process of inquiry. These are all essential aspects of productively working with knowledge and are routinely practiced within knowledge intensive organizations. This perspective is clarified in [16].

Carl Bereiter and Marlene Scardamalia are strong advocates of student communities working together to become proficient in fields of knowledge. They introduced the concept of knowledge building communities, where students learn to work with theoretical and practical concepts as objects. They strongly advocate that students become knowledge builders and active participants in knowledge building discourse. The focus here is firstly, on problems and the depth of understanding, secondly, it focuses on decentralized, open knowledge environments for collective understanding, and the third focus area is on productive interaction within broadly conceived knowledge building communities. Knowledge building theory was created and developed for describing what a community of learners needs to accomplish in order to create knowledge. The theory addresses the need to educate people for the knowledge age society, in which knowledge and innovation are pervasive [4] and [53]. Twelve identified principles of knowledge building are proposed by Scardamalia (2002) [52].

Networked expertise is defined in [17]. It refers to competences that arise from social interaction, knowledge sharing and collective problem solving, and which are embedded in the shared competence of communities and organized groups of experts and professionals. Cognition and intelligent activity are thus not limited to an individual's mental processes but also encompass socio-culturally developed cognitive tools. These tools include physical and conceptual artifacts. Networked expertise is rational and is constituted in interaction between individuals, communities and larger networks that are supported by cognitive artifacts. It also co-evolves with continuously transforming innovative knowledge communities. The approach emphasizes the development of expertise, distributed cognition and shared expertise, collaborative and cultural learning, and inquiry based learning processes.

The theoretical background of LbD has been constructed to fulfil the three metaphors of learning [31]. The first (1) perspective is a metaphor for knowledge acquisition and conceptualizing learning as a process of transferring knowledge to an individual learner. The second (2) perspective is a metaphor for participation, which emphasizes the role of social communities in learning and professional development. The third (3) perspective is a metaphor for knowledge creation, the aim of which is the purposeful generation of information and the development of related social customs. Its focus is on investigating the mediated process of knowledge generation [31] and [17]. The nature of this theory binding in creating categories in LbD is included in Fig. 2.

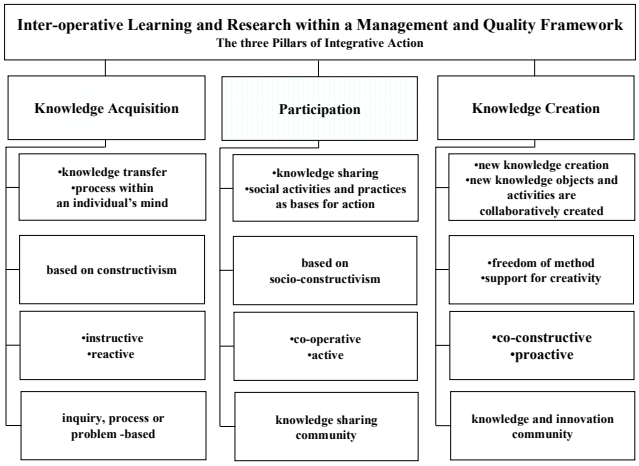

Fig. 2 the three metaphors of learning are not exclusive; all of them are necessary and important in applied cases. The three perspectives are extended to learning, design and management in Integrative Action.

A glossary on the perspectives is presented in [17]. The acquisition metaphor (1) of learning is a view of learning that emphasizes learning as a process of acquiring a desired piece of knowledge or knowledge structure. Knowledge is understood as a matter of the individual mind. The participation metaphor (2) of learning is a view of learning that emphasizes the process of participating in various social practices and shared, learning activities. The knowledge-creation metaphor (3) of learning is a view of learning that emphasizes learning as analogous to the processes of innovative inquiry in which an individual's initiative is embedded in productive social and institutional practices. The focus is on the process of advancing knowledge, transforming

social practices and developing expertise. This view is becoming more important in modern society; especially in learning, design and management [40].

B. Dimensions of LbD

LbD is a pedagogical and collective approach in which learning is linked to an applied research and development culture. It emphasizes learning expertise that arises from social interaction, knowledge and competence sharing, researching and problem solving [14] and [12] related to collective objectives [17] and [16].

The "dimension model" emphasizes cooperation and the creating of a "learning and developing" culture, which makes it possible to include and use various scientific perspectives and methods of learning, and research and development in operation and action. The model represents a management and work philosophy based on the production of shared competence and creativity.

In the dimension model of LbD the four layers may rotate in different positions independent of each other during the implementation phases. Thus, the dimensional model can be understood by implementing different elements in a learning cycle and for describing a learning culture. The dimensional model of LbD is illustrated in Fig. 3.

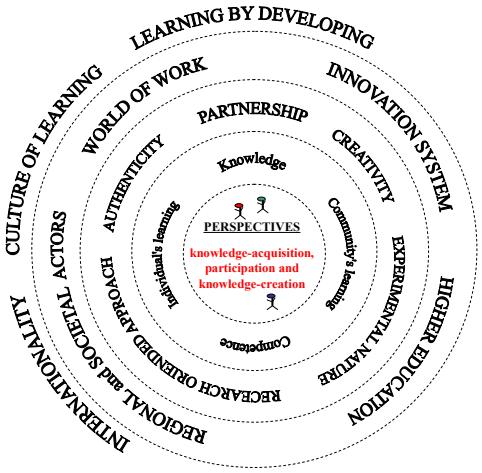

Fig. 3 illustrates the integrative dimensions of LbD and its three perspectives of learning: knowledge acquisition, participation and knowledge creation. The dimensions of learning are the individual's learning, the community's learning and building new know-how. The features of LbD are support for creativity, partnership in action, a basis in authenticity, an experimental nature and research with international cooperation. The "dimensional model" supports the construction of creativity and innovations, where learning does not follow any fixed process model but the supportive construction of courses brings out the dimensions in complementary ways. Thus the LbD model is a dimensional model of culture rather than a categorical one.

Innovative learning cycles do not follow any fixed process order [11], but cumulative learning is implemented as a whole, and covers competences defined in a curriculum and implemented in a syllabus with "no upper limit". The proposition [46] and [41] focuses on the fact that LbD has a learning culture in which proactive knowledge development and learning has the following meanings for the participants and actors involved:

1) For the learner, LbD means growing up in a culture that focuses on expertise which arises from social interaction, knowledge sharing and collective development. This implies growing up with the lifestyle of a developer, immersing oneself in proactive learning and personal knowledge management.

2) It also means increasing the value of innovations for all co-operators in applied research and development and creating new knowledge, competences, innovations, service products and practices.

3) For a university of applied sciences, it means changing its organizational and cultural role towards becoming a cooperative community regarding the creation of new knowledge and expertise. This means that an institution's own development process enriches the expertise within its community and increases its role in a value network by being a cultural prime mover and a new actor sharing innovations within a network.

4) The LbD culture contributes to regional development by having students interact with other regional participants in projects, and especially by playing a strong role in creating international links.

The dimensional model underlines the relationship between cultural mutability and learning and results in the making of a more creative culture. Creativity itself is seen as the result of shared inspiration, cognition, participation and social knowledge sharing in a social context.

C. Category-Elements of Integrative Action

The common elements of Integrative Action are proposed in [40]: there are several needs for a clearer specification of different Integrative Action types.

The first reason is the confusion with regard to practical management. However, a completely different type of management is required for different actions in the Integrative Action model. The second reason is the core idea behind the "changing of objectivity", which refers to the balancing of subjectivity and objectivity to support creativity. The third reason is that commercially beneficial innovation and invention is impossible without radical intervention. The fourth reason is the fact that we live in a time of globalization which, for many reasons, requires that future business will focus more on creativity and innovation. The fifth reason is that good quality is important and requires different types of action in order to be achieved e.g. it must take creativity and innovation into account and ensure that research also includes relevance, validity and rigor. The sixth reason is that the application of the pragmatic theory of knowledge and the activity of innovation orientation both require different types of agility, action and flexibility.

Based on these reasons, a clearer definition is sorely needed in order to differentiate between and clarify different actions. Four elements are specified in [34] and are:

1) Cyclic, which supports creativity and innovation. This element emphasizes the importance of creations: (anything created) e.g. the mental creation of an intangible idea; the physical creation of something tangible; a social creation, such as spirit or trust in the interaction of a value network. The cyclic element underlines the use of the "non pragmatic" aspect of creativity as well as the freedom part of the methods and philosophies in action and design.

2) Thematic, which is used to support the structure of the co-creation of lead innovations by using thematic scopes to integrate action and cooperation within thematic regions, thematic cities, thematic living labs [71], ongoing R&D, thematic curriculum, courses, and evaluations.

3) Linear, which supports the implementation of research, as well as development and action processes and work systems.

4) Relevant, which supports validity and scientific rigorousness, and ensures that the quality and action produced are relevant. This element includes the essential part of quality management systems e.g. quality measures and the qualitative documentation of actualizations. The elements as categories are illustrated in Fig.4.

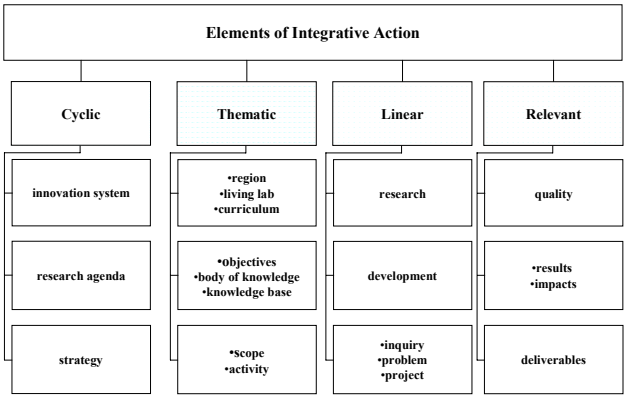

Fig. 4 illustrates the integrative elements in Integrative Action, the element-categories are proposed for the better understating of different orientations and inter-operative actualization: learning; management/leadership; transformations; and design within innovation systems.

D. *Integrative Action Process*

Integrative Action related to the three tasks [40] and [44] builds bridges between technologies and applications to allow research results to be turned into competences and economic success. Thus, innovation alliances should be made between various stakeholders, particularly in science, business and politics. In the Integrative Action model, vertical cooperation, namely lead innovations [65], are geared toward certain services, applications and branches with specifically coordinated support contributions from technological areas. In integrative cooperation, "technological alliances" for pursuing technological objectives are jointly created with science and business through shared service platforms. This "lead innovation ecosystem" of Integrative Action includes the different types of cooperation, action and activities.

The main contribution of Integrative Action and the process model was the creation of a linear development framework for cyclic innovation activities that have a research, action and quality perspective [66], [69] and [63], illustrated in Fig.5.

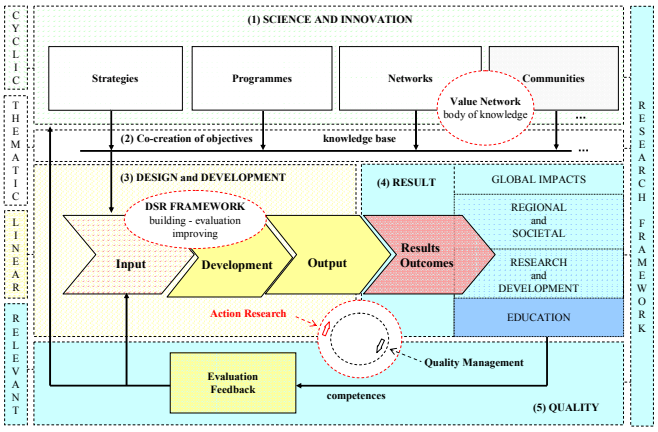

Fig. 5 presents the general Integrative Action and Research Model. The dual imperatives of Action Research are problem solving and research, which are both implemented in the linear and relevant elements. The nature of Design Science Research is linear and Service Design influences the thematic collector. The elements were used as full duplex and co-creative interfaces. The research and development work in action (in the syllabus) bridges knowledge (the collector) and the competences (the curricula). The quality management system emphasizes the confirmation of quality and actualization and furthers development work.

The Integrative Action system itself is a kind of extended linear "work system" [1] and [33] within an innovation system framework and a liberation process for innovative activities, rather than a fully automated process for innovation and invention generation. The definition that an information system is seen as a work system in [1] complements the linear and relevant elements in Integrative Action; the perspective includes customers, products, services, processes and activities with participants, as well as information and technologies.

In practice, innovative learning cycles do not follow any fixed order [11] and methodological freedom and creativity are emphasized in the orientation to an innovation. Hence, the nature of an integrative process is to support rather than manage cyclic and thematic elements.

The Integrative Action model may also exist as a pure linear development environment without research e.g. if a cooperative participant or firm do not want to do research, but willingly participate in the development or problem solving parts of a project [19], [12] and [14].

Integrative Action focuses on mentoring, group work, professional communities, novel methodologies, living labs, spirit and flow, trust, and value in authentic value networks. Various versions and products of the Integrative Action model are demonstrated in [43], [44], [45] and [47].

E. Value Network Categories in Integrative Action

Collaboration and cooperation between universities, industry and government sectors has shown that it is extremely efficient to integrate actions and values [38] as a participant's interests and motivation is based on values, the value gained from a network and the value given to a cooperative network. This "participant and participation driven network model", in which participants have a value relation to a network, is called a Value Network. Similar networks include a Network with Value or a Regional Value Network which should have potential value for people and citizens who personally participate, cooperate or have a relationship with a network. Figure 6 presents the categories of the Value Network in its cyclic and thematic role in Integrative Action.

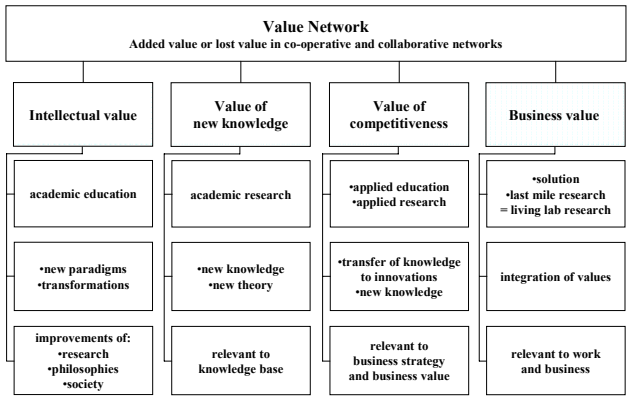

Fig. 6 proposes a categorization of the Value Network model. The term value relates to being important or beneficial. It is actualized in the perspectives of added or lost value and both possibilities are present in a value network. LbD and integration action places value networks in cyclic and thematic roles to promote the retention of students, engagement and achievement e.g. identity, trust; motivation; competence; equality; intensity of learning; and partnership. The categories are analysed according to the evaluation and application material of Laurea's evaluation transactions 2003-2009. The categories of intellectual value and the value of competitiveness describe the dual university model in Finland.

In Finnish terms, the major innovation system operators are located in the Helsinki metropolitan area, so Laurea's regional role centers, in particular, on its ability to network and share information and competences between various regional centers and the actors in those centers.

In the metropolitan area, Laurea's role is to act as a university of applied sciences that promotes the integration of the metropolitan area. In this area with its multiple players, Laurea's strategic choice is to participate consciously in development programmes, which bring various players together. Laurea participates in all the numerous programmes related to centres of expertise and regional centers in its area of operation, including the Members of the International Service Design Network [68], the Strategic Centre of Science (SHOK) and the European Network of Living Labs [71].

Laurea's operations are always available to businesses and because it is a major innovation system operator it has also benefited and improved the innovativeness of its own organization, products and processes through such cooperation. Additionally, it also works on collaboration between public sector bodies, businesses and universities with respect to innovation work.

V. Research in Integrative Action

The integrative research framework includes various types of research approaches: action research is sustainable and embedded into the Integrative Action and LbD learning culture for producing knowledge in order to guide the practice of the modification of action [2], [3], [6], [25] and [29]; case studies are made to gain a detailed understanding of interesting scopes and innovations [61]; design research produces viable artefacts, inventions, innovations and services [27] and [18]; design science produces the knowledge to implement an innovation [21] and [20]; a proactive approach is used for influencing the future [59]; service design is an activity aimed at materializing the non-material dimensions of services [55] and [26] in information systems [70] and [33]; Validity, relevance and the rigorousness f research work are also implemented in the linear and relevance elements of an Integrative Action process. Furthermore, our natural research scope also produces synergies between the behavioural, psychological, educational and sociological sciences [17], [39] and [42].

A. Action Research Form

The discipline of information systems (IS) is an appropriate field for the use of AR methods. AR methods are clinical [2] and [3] in nature, and place researchers in co-operational and co-creative roles in an Integrative Action environment. According to [2] the AR method was developed in the social sciences. Kurt Lewin (1947) is credited with developing the method at the Research Centre for Group Dynamics in the University of Michigan.

Lewin conceived of AR as a spiral of steps examining a problem situation at ever deeper levels through the people and organizational structures involved in an organization's system and through a series of research-informed action experiments [10]. According to [2] and [10], Lewin's original action research included the iteration of six phased stages 1) analysis, 2) fact-finding, 3) conceptualization, 4) planning, 5) the execution or implementation of action, and 6) fact-finding or evaluating the result of the actions.

According to Lewin [25] and [24] the reconnaissance stage should provide data if the target field has changed significantly. The result of the reconnaissance after the first step should be twofold: first it might be necessary to alter the general plan; or secondly, make a final decision on the next step. After the first action has been completed, the second step should not follow automatically. Instead it should be investigated whether or not the effect of the first action was actually what was expected. After the second step further

reconnaissance follows, leading again to the alteration of the general plan and a decision on the next step. Accepting the plan does not mean that all future steps are fixed by a final decision. That occurs only if the decision in the first step is final.

Lewin [25] stated that planned social action usually emerges more or less from an "idea". An objective appears in the form of a dream or a wish, which hardly can be called a goal. To become real, something has to be developed which might be called a "plan". The transition from idea to a plan presupposes that; first the objective is clarified; second the path to the goal and the available means to do this are determined; and third the strategy of action is developed. These three items together make up the general plan.

Also based on Lewin [25] and [24], firstly, it should be noted that the development of a general plan presupposes "fact-finding" and for it to be effective the plans should also be flexible. Secondly, on the basis of fact-finding, the goal is usually somewhat altered in light of the findings concerning the means available and possible.

Another group [2], which worked independently at the Clinic and Institute of Tavistock developed a similar method, which is seen as a psychological equivalent of action research. They used action research to study psychological and social disorders among veterans of battlefields and prisoner-of-war camps. Each case appeared somehow different; hence the idea of social action arose. The effects of the changed aspects and action were recorded and studied. In this manner, a body of knowledge was developed.

An initial chronological sampling of the AR field is provided, so that the four pragmatist premises that form the major set of assumptions emphasized in Lewin's action research methods [2] can be traced. They are Charles S. Peirce's (1839-1914), William James's (1842-1909) and George Herbert Mead's (1862-1931) tenets and John Dewey's (1859-1952) logic of controlled inquiry.

The genealogy and diversity of AR in IS is clarified in [3] and [6], both papers include Lewin (1947) in the area of group dynamic; Blum (1955) in the philosophy of science; Clark (1972) in the field of organizational change; and Susman and Evered (1978) in the evolution of the scientific merit of action research in terms of post-positivist science. This was followed by a meticulously-developed definition of the important aims of the approach by Hult and Lennung (1980). The cyclic model of action research was developed by Susman and Evered [56].

Action research in information systems has been continued in [2] by: Checkland (1981 and 1990) on systems thinking; and Wood-Harper (1985) on AR in IS; and by Baskerville and Wood-Harper (1996), who explore the practical domains of AR. The classification of AR in the field of IS was inventoried by Lau (1997).

B. Organizational Change and Action Research

AR aims to solve current practical problems while expanding scientific knowledge. Unlike other research methods, where the researcher seeks to study organizational phenomena but not to change them, the action researcher is concerned with bringing about organizational change while studying the process.

In the author's ongoing dissertation, AR is strongly oriented towards collaboration and change, involving both researchers and subjects. It is iterative in scope and is a continuous research process that capitalizes on learning by a researcher (as a member of an expert community) and other participants (e.g. students, colleges, collaborators and management). It is a clinical method that puts researchers in a cooperative and co-creative role.

The philosophy for much of AR is pragmatism; the pragmatism concentrates on asking the right questions and receiving empirical answers to those questions [2]. AR provides a method for explaining why things do or do not work [2] and [6].

AR is an interventionist approach towards the acquisition of knowledge and has its foundation in the post positivist tradition. It assumes that a complex social process is best studied by introducing changes in that process and observing their effects. It links theory and practice in a cyclic process, which means binding theories and practice in the Integrative Action process [32]. The intention is to create a synthesis with specific knowledge that allows actors to be in a situation and have the ability to act and generate knowledge that is useful for other, similar situations.

C. Categories of Action Research in Integrative Action

The studies that have used Integrative Action at Laurea have combined theory and practice and been mainly based on Susman and Evered's (1978) classic AR process [63], as well as Checkland and Holwell's (1998) AR cycle [6], and McKay and Marshall's (2001) model [36], which also references Susman, Evered and Checkland and Howell in relation to problem-solving and research interest. This approach is widely used [2] and is, in this case, implemented inside the Integrative Action process, so Integrative Action is seen as framework and it includes both a problem solving interest cycle and a research interest cycle as arguments in [32] and [35].

The AR model within Integrative Action consists of five consecutive phases that are repeated, so that the results of one process cycle feedback as inputs for the next cycle. The phases of the used AR cycle are:

(1) Diagnosis and reflection i.e. reflection on the work or the work environment from the perspective of the three statutory tasks; raising questions; and recognizing and specifying a problem area to be researched and treated with new forms of action or changed actions.

(2) Action planning, which involves learning about a problem and planning for a change by introducing and being self-motivating in the co-creation of strategies, scopes, plans and implementations that use the organizational bottom-up model [34], [35] and [36]. In particular, planning also connects the thematic and linear elements to AR, but the

research interest is linear and relevant.

(3) Action taking which changes the ways in which work is carried out. This is done by implementing changes and connecting the linear element of Integrative Action to AR.

(4) Evaluation, which is the assessment of the effects of change through the evaluation of the resulting new situation and the success of those changes involving the relevance of the elements of Integrative Action.

(5) Specifying learning, which reflects on what has been learnt and how a whole effort has been reported and updated to the relevant knowledge base [16] and the body of knowledge documented.

Future research interventions then continue from the next focus area, which emerges from this phase. In Laurea's case it temporarily continues from the initiation stage. Slight variations in the cycle (e.g. more fine-grained phases) have been proposed, but the five steps mentioned above contain the essence of Laurea's approach, which is to induce change to tackle a problem in an organization while providing supporting research that influences the co-decisions made on what to change and how to change the linear and relevance aspects. The cycle of AR is illustrated in Fig. 7 where the phases are represented as categories.

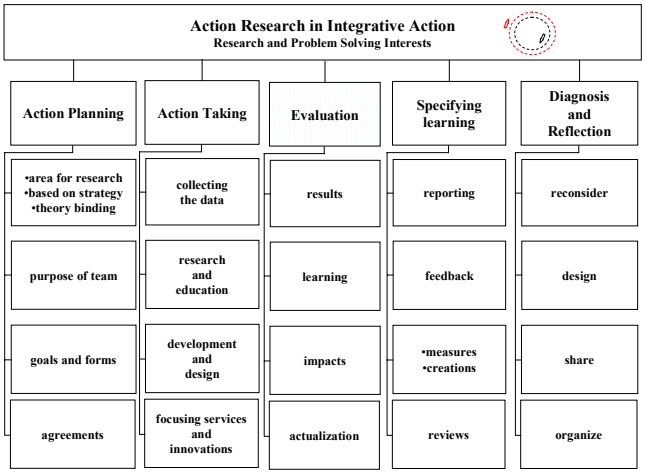

Fig. 7 Actualization of Action Research occurs inside the Integrative Action model and belongs to the linear and relevant elements. In particular, the thematic elements exist in the action planning and specifying learning phases but the research interest addresses the linear and relevant elements.

D. Categories of Design Research in Integrative Action

Design research (DR) is also rooted in pragmatism in discussion [15]. For the pragmatist, truth and utility are inseparable as truth lies in utility. Thus, for DR, relevance is evaluated by the utility provided to the organization and its developers. A DR must pass both the tests of science and practice [28]. Different terms have been used to describe this mode of research, including Design Science [58] and Design Science Research [18], which consists of activities concerned with the construction and evaluation of technological artifacts to meet organizational needs as well as the development of their associated theories.

Consequently, design research is concerned with artificial rather than natural phenomena and is rooted as a discipline in the sciences of the artificial [27]. One set of guidelines for the conducting and evaluating of a design research is the seven elements of 'DR criteria' [16]. DR must necessarily make a dual contribution to epistemic and practical utility. Any piece of research must add to existing theory in order to make a worthwhile scientific contribution and the research should assist in solving the practical problems of practitioners, specifically problems that are either current or anticipated. The extended design science research framework in Integrative Action is illustrated in Fig. 8.

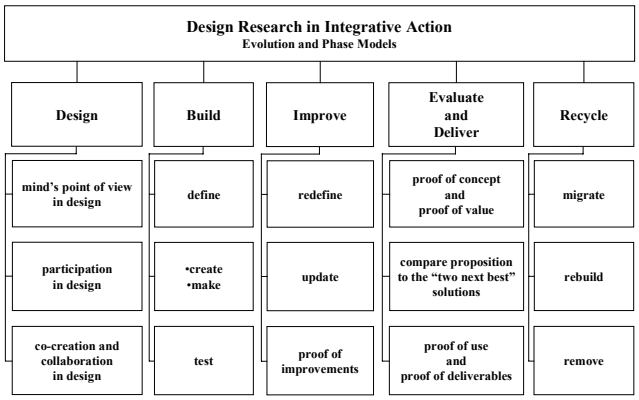

Fig. 8 The aim of the proposed extension of the three perspectives to the Information System Framework (ISF) is to add more support for creativity to it due to the importance of mental creativity and co-creations in IS design. This is applied within the ISF that works within Integrative Action, because Integrative Action links value networks and motivation based creativity and is a bridge from thought based activity to collaboration and furthers enables the linear build-evaluation development process. This is important because an "early innovation issue, a hidden innovation or method" may exist without a problem and so it is necessary that thought processes, participation, creativity and co-creation are supported in the design. This view focuses on a paradigm shift from problem based thinking to the support of creativity and "learning by design" thinking in an ISF (the extension from problems to social scopes).

Two research methods in the IS field with this dual orientation are DR [27] and [18] and AR [2], [6] and [20]. DR consists of activities concerned with the construction and evaluation of technology artifacts to meet organizational needs as well as the development of their associated theories.

In brief, behavioral science is concerned with theories that explain human or organizational behavior, while DR is concerned with creating new and innovative artifacts [21].

Action builds bridges from knowledge to competence and bridges design to the development [30] and making of a commercial product, although this involves different processes, goals and theoretical assumptions. Based on that, Integrative Action connects an innovation system to these perspectives through the behavioral sciences, e.g. psychological, sociological and educational in which [17] produces advanced theoretical judgments.

VI. Quality in Integrative Action

A. Interests of Quality Management Categories

There are several reasons behind the categorization of quality systems at Finnish universities of applied sciences: a) the quality audit in 2010, which is the official authorization of the quality systems of universities and is conducted by FINHEEC; b) to certify quality; c) to discover, confirm and verify quality; d) to aid the development of processes from the perspective of actualization and production e.g. the quality control perspective [54]; and d) data concepts for quality system development work e.g. the interoperability of quality management systems (QMS) and shared services in QMS, particularly IS [12], [19] and [57].

B. Formulation of Quality Management Forms

In this actualization all the employees and co-operators of the expertise organization develop their own work and the nature and quality of their own community of expertise. They also use a quality system for the management, development and verification and confirmation of quality (in the case of Laurea there are 500 faculties, 8000 students and about 70 cooperators).

There are two imperatives behind quality management in an organization based on expertise: 1) quality implementation and confirmation interest and 2) the development and verification interest. This situation is similar to but not the same as the two imperatives of AR 1) research interest and 2) the problem solving interest [29]. It is accepted that these four different perspectives complement each other in Integrative Action.

One of the most well-known and evergreen management models, the so called Deming or Shewhart cycle, or PDCA model (plan-do-check-act) or (plan-do-learn-act) [9] is "light enough to use and meaningful for co-operative action" but nevertheless very useful and inter-operative in the context of quality and management that includes leadership and development.

Walter Andrew Shewhart (1939) described manufacture made according to statistical control as a three step process of a) specification; b) production, and c) inspection in [54]. Shewhart continues that this is specifically related to the scientific method of a) hypothesis, b) experiment, and c) evaluation. Shewhart states [54] that a) hypothesis has similarities to specification; as it is the concept of using a statistical state to ascertain the limit to which one may hope to go in improving the uniformity of quality; b) experimentation has similarities to production, which is seen as the operation or technique of obtaining uniformity; and c) evaluation has similarities with inspection, which is seen as providing judgments.

The PDCA model became well-known through W. Edwards Deming, although Deming called the model the Shewhart cycle after its inventor and form. It is also called Deming's Wheel. Deming published the methodology in his book Out of Crisis (1982) [9]. For Deming the PDCA model was "a flow diagram for learning and for the improvement of a product and a process".

The PDCA model corresponds to the general principle of managing a system according to general systems thinking, systems dynamics, or cybernetics. Joseph Juran's Trilogy model: 1) quality planning; 2) quality control; and 3) quality improvement includes similar action elements to the PDCA model.

A modern application of the PDCA model is the SixSigma methodology for an organization's performance improvement. Its most general activity phases are DMAIC – Define, Measure, Analyze, Improve, and Control. Furthermore, in DR the design and optimizing as well as demonstrations and verification are emphasized, so the SixSigma methodology for the actualization of the three tasks in Integrative Action should include the phases DMADOV: Define, Measure, Analyze, Design, Optimize and Verify.

In Integrative Action the PDCA model using the "DMADOV quality sigma" describes how management consists of four activities:

- Plan: Planning the activities i.e. what should be done and what results should be achieved and what is it necessary to change in the actualization? This concerns the co-creative and participative nature of planning (e.g. achieved competences) and the implementation of definitions into the design and optimization of the quality sigma.
- Do: Doing the actualization and implementation according to the plan, actualizing and implementing interests, and co-operating and participating as well as generating new knowledge from the creation perspective of doing (e.g. the learning process). The data collection and implementation of measures are actualized.
- Check: The checking of the activities and the results achieved, which involves development, the research interest, the knowledge creation interest (e.g. the reviewing of reports and updating of the syllabus), the implementation of analysis, measurement and verification interventions in the quality sigma.
- Act: Acting rationally and systematically, taking into account the observations and results of the checking regarding the consequences and implications of the actualization for the next stage and the body of knowledge e.g. the binding of new theories and the writing of a draft for next syllabus.

C. The Objectives of the Quality System

The QMS in Integrative Action is seen as a supporting activity for the actualization of strategies and the achieving of the "shared vision of wanting" in practice. Its first objective is quality confirmation and verification in the actualization process of the three statutory tasks.

The second objective of a QMS is its contribution to development work. The quality system includes systematic methods of data and feedback collection, analysis and reflection, so it creates needs and scopes for future evolution and development cycles. This cyclic working system is key to the support of agility, mutability and malleability in the inter-

operative value network.

The actualized QMS systematically produces and describes data from education, research and development as well as regional development processes, activities and implementations. These processes are described in the form of process models and service descriptions in the QMS. Furthermore the quality related data is collected systematically for development purposes, which makes it possible to certify most results online.

The principle behind measuring and having qualitative feedback is open access to results. Thus, the curriculum, syllabuses, theses, reports and results are accessible and contribute to finding deviations in quality in the processes of the three tasks and thus help to balance action in general. In this actualization method the quality system is implemented in the everyday action of Laurea's community.

D. The Categories of Quality Management

In this case there were several possible perspectives and settings for the foundation of categorization work: 1) the analysis of development plans (inductive); 2) the analysis of the strategies (inductive); 3) the analysis of action and actualization (deductive and partly inductive); 4) the analysis of evaluation reports (inductive); and 5) the analysis and possible consequences of the three statutory tasks (inductive).

Our main selection was 3) the analysis of action and actualization. The reasons for selection are: usability in an organization, the fact that the plan-do-check-act quality system is more familiar than new inducted categories would be and the inter-operability of categorization with canonical evaluation [8] and AR [2]. This makes it possible to combine all four interests (confirmation of quality, development, research and problem solving) within the same Integrative Action framework. Thus, the core categories of plan-do-check-act and the design research base (build-evaluate-improve) already exist in Integrative Action.

In addition, the proposition of categories for the QMS at Laurea is based on current QMS processes (plan-do-check-act). Hence, the name of the main category is naturally the same as the phase name in the QMS process. First: the PLAN category, which also has two sub-categories; integrative and strategy. The integrative sub-category places Laurea in an international and co-operative environment for the innovative action aspect and stresses that research and development is understood as a strategic partnership instead of a commissioned project principle. The strategy sub-category emphasizes the importance of strategies in action e.g. implementations and actualizations are based on the strategies of; pedagogy; research and development; and regional development. Second: the DO category includes the action process where the core process is the development base learning process and the sub-processes are the education process and "strategy within management" process, plus the personnel process. Third: the category of CHECK where reflection and evaluation takes places, this category is based on the plan of strategy implementation and covers research and development work, regional development work, action within LbD, the education process and the management of competences. Fourth: the category of ACT includes implications and consequences for development. It stresses: methods; ways of acting; and tools and these address building, evaluating and improving all processes inside Integrative Action. These actualization and action based quality categories are illustrated in Fig. 9.

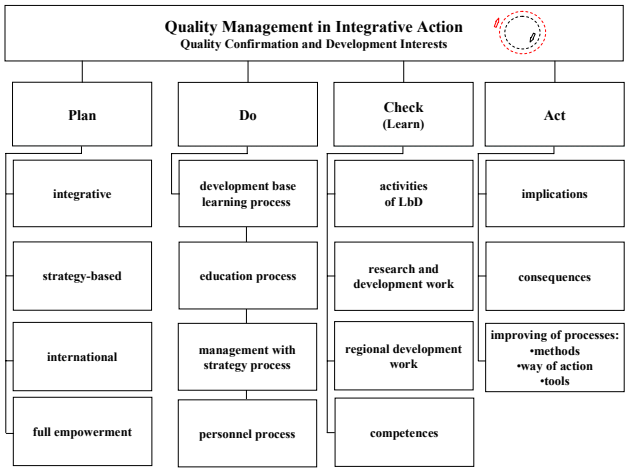

Fig. 9 proposed quality management categories are based on the actualization of three tasks from the perspective of quality confirmation and actualization. These categories are inter-operative with AR, so it is possible to combine all four interests of Integrative Action: 1) confirmation of quality, 2) development, 3) research and 4) problem solving.

VII. Description of the Cases and Demonstrations

A. Action Research in Integrative Action

The study in [32] examines the setting of Canonical AR [8] in an Integrative Action process within an LbD culture. The evaluation phases of the performed action research are based on the evaluation transactions and documentations of FINHEEC and a canonical evaluation of the research can then be produced. Canonical is defined as "exactness" or "strict precision" and it is understood as "a generally accepted principle" in the context of the widely practiced and reported form of action research in IS literature. The performed study developed and tested Integrative Action and design principles in the research and practice of implementing the three statutory tasks of Finnish universities of applied sciences. The term canonical was used to formalize the association of the iterative, rigorous and collaborative process oriented model of AR. The study's two action research cycles addressed the evaluation transactions of excellence in higher education 2003-2006 and 2006-2009. LbD successfully influenced Laurea's appointments as a Centre of Excellence in Education for 2005-2006 and 2008-2009.

The AR in [35] presents the two research cycles that address the regional development task. In this research both cycles include an evaluation by FINHEEC. The Integrative Action and internationalization efforts within value network

collaboration helped Laurea's appointment as a Centre of Excellence for regional development for 2003-2004 and 2006-2007. The main contribution of Integrative Action and the process model has been the creation of a linear development and learning framework for cyclic innovation activities with a quality perspective based on [66], [69] and [63].

AR and DR exist in the body of master studies in the IS curriculum. These studies are based on AR and IS's design science research transactions within the thematic scopes, innovation system and competences described in [22].

B. Two Imperatives of Learning within Design Research

There are two imperatives in the integration of LbD and the DR of IS. In general, if the innovation center based objectives and lead innovations are used in education, then learning action creates deeper and more relevant knowledge and competence for expertise communities than a workplace's or student's own themes or areas of interest [23]. This is because the innovation topics and research areas for innovation centers are deeply analyzed and verified from a future perspective. Furthermore, this does not include any major contradiction with creativity as it is possible to keep the creative scopes and themes of the innovation center flexible, motivating and creative enough for students in the Integrative Action process [40].

The second empirical perspective and imperative takes place in form of the two examples: the security and ICT cases SATERISK (risks of satellites) and FLOODWARE (flood readiness and research of flood systems), which are both large, global R&D projects. The Integrative Action model was implemented to enable knowledge creation and the globalization of transformations. The idea, foundation, focus, themes, topics and spirit of SATERISK were further elaborated by students, so SATERISK is purely a student innovation and creation. This means that student driven creations and designs also lead to the thematic collector and that innovation center based objectives may be the co-creative creations of students. Reference [17] produces advanced judgments that are essential for this perspective of creativity in learning as they focus on students' own creations (designs) and promote the use of mental scaffolding (structures in learning). Hence, all co-instructive, co-operative and co-constructive creativity is supported in the LbD culture [32].

C. SATERISK – Satellite Tracking Risks

The idea to study risks related to satellites was created by students of Laurea University of Applied Sciences in 2008. Funding from TEKES (Finnish Funding Agency for Technology and Innovation) was secured on 14.11.2008 and allocated for the period 1.9.2008 to 31.8.2011.

The goal of SATERISK is to study the risks connected to satellite tracking and to ascertain if the use of satellite tracking can generate further risks. The project analyzes risks using different approaches: legal, technical and mode of use. It will also study potential future requirements and risks.

SATERISK is a project of Laurea University of Applied Sciences, Safety and Security Management Department. It collaborates with the University of Lapland, the Institute of Air and Space Law, which has its own project studying the regulation and legal risks of satellite tracking. Both projects have the same steering group. The sponsors of SATERISK are TEKES as well as industry partners from the whole value chain of satellite tracking: EADS DS, Finnish Customs, Loomis Ltd., Portalify Ltd., Trevoc Ltd. The project also collaborates with universities in the UK, the USA and Russia.

The University of Lapland concentrates on regulation and legal problem areas, such as privacy protection, information security, state sovereignty, safety and responsibility and liability issues. The studies have the geographical focus: national, EU and the Schengen Region, Russia.

Laurea concentrates on risks connected to technical solutions and equipment, which are generated by the mode of tracking. Results from the legal research will also be utilized. Risks are analyzed mainly from the tracker's point of view. Laurea will study future requirements for when new satellite systems like Galileo and new end-user systems and mapping and tracking solutions are in use. Scenarios for future risks will also be developed.

The project will produce reports on 1) problems and risks in satellite tracking from the tracker's point of view 2) new features and opportunities enabled by Galileo and 3) the new features needed for equipment and applications used in professional tracking and mapping systems. It will also make proposals for future improvements.

D. Rescuing of Intelligence and Electronic Security Core Applications (RIESCA)

There are a number of systems, such as transport and logistic, power and telecommunication, hydropower and nuclear power stations that are critical to the day-to-day functioning of any advanced society such as Finland. When assessing possible risks, it is only seldom taken into account that power, hydropower and nuclear power plants are critically dependent on the reliability and security of IS. Information security is often enhanced by purchasing and extending technical solutions without considering any systematic planning and knowledge of how to protect the different segments of a system. Hence, the risk is compounded not only by the investment of information security resources into the wrong targets but also by the unplanned integration of systems, plus information security components may even create new security risks. In consequence, systems that are critical to the proper functioning of society may not work as well as they should. RIESCA aims to offer contributive and constructive solutions to this problem. The research project will produce information security management methods that can be used to ensure the proper functioning of critical systems under varying circumstances.

The national project partners are: the University of Oulu, the University of Kuopio, and Laurea University of Applied Sciences. The international research partners are: Macquarie University, Sydney, Australia; the University of Arizona,

USA; and the Software Competence Centre Hagenberg, Austria. The resources available also include individual students or larger student groups assigned to defined parts of the project. There are two notable advantages conferred by the use of students on the project, namely: confidential information management can be used and developed; and the students acquire more professional expertise that fits with the principles of Laurea's LbD development framework. The contributors to RIESCA are: TEKES, The Ministry of the Interior, Ministry of Defense, Civil Crisis Management Center, Finavia, EADS Secure Networks Ltd., Ixonos Ltd., Softera Ltd., Portalify Ltd., and Insta Ltd [44] and [45].

E. Open Rendering Environment (ORE)

Rendering is the process of generating 3D (three dimensions or three-dimensional) images and movies on computers. The ORE (Open Rendering Environment) project aims to bring the BOINC (Berkeley Open Infrastructure for Network Computing) based BURP (Big and Ugly Rendering Project) distributed rendering service to Finland. This goal was realized by the opening of the "Renderfarm" service in June 2009.

The Renderfarm service is the world's first publicly distributed rendering service advocating the use of Creative Commons licenses. The ORE project also aims to help companies and universities adopt the open source 3D modeling suite Blender into their everyday workflow. While creating new information about social behavior and distributed computing, Laurea and the project also function as a pilot project for TEKES as it researches the possibility of using Finnish universities of applied science as supporting structures for bringing new technologies into the reach of small and medium enterprises.

VIII. Results Categories

A. Results and Challenges of Role and Position

The results of evaluations of education and regional impact show that the role of universities of applied sciences has developed considerably, the main focus has shifted to regional R&D work and a promising regional and societal influence has been achieved. Research and development is now understood as a strategic partnership instead of a commissioned project [48], [50] and [51].

This "role or position in society" perspective is challenging [64] because it needs a cultural transformation in education to succeed. It is possible to adapt and transform the LbD cultural framework, although an organization has to create its own form of culture.

Student's competences: Students were especially satisfied with improvements in the development of their own competences and universities of applied sciences have acknowledged the huge potential and realistic possibilities for implementing their statutory regional development tasks and other authentic societal challenges [50], [51] and [60].

The main challenge, however, involves the paradigm shift in education and methods related to the "research of impacts". If this is based on thinking regarding knowledge creation, which is produced by researching as well as developing and learning in an expanding, future direction, then it needs to produce beneficial changes for institutional systems, in the positions, roles and attitudes of students, teachers and participants [32], [35] and [60].

B. Results of Networked Expertise

The network expertise perspective has become more common and brought together education, R&D and entrepreneurs as well as work environments and innovation systems [67], [48] and [50]. In particular, the future tasks of this innovation policy are linked to the increasing participation of entrepreneurs and enterprises.

The challenge is that only 4.3% of enterprises considered the importance of cooperation with higher education institutes to be significant or great [64], [48] and the statistics also show that only 36% of enterprises cooperated in innovation activities with higher education institutions in Finland. Research from other European countries has produced similar or even more challenging results [64].

The new SHOKs (ICT clusters of the Finnish Strategic Centres for Science, Technology and Innovation) are trying to address this by connecting enterprises and higher education institutions more closely to applied research and by attempting to make use of the research produced by using it to improve an enterprise's business competitiveness.

C. Results and Challenges of LbD

The analysed strengths of Integrative Action and LbD from the students' perspective are; improved employability, effective participation in authentic development projects, learning situations in which students are at the centre of the action and involve development work, highly experimental learning, raised aspirations, improved social skills and self confidence, the ability to take personal responsibility for results, contact with companies and organizations, the ability to train others and manage study events and the possibility to create something new [60], [50] and [51].

The challenges of Integrative Action from the students' perspective are the fact that the system relies hugely on group commitment, the building of motivation and training through action i.e. how to reach strategic and important scopes and deal with new up-to-date knowledge (last known context) in a more systematic way. They also found that "learning in this way" takes much longer than "being taught". Other difficulties included finding an optimum ratio of direct inputs, scopes and initiatives, dealing with the responsibility required by authentic work situations, complexity management, the management of social situations, and a lack of ability or skills when participating in mentoring, and peer reviews and evaluation in general [60], [50] and [51].

D. Feedback from Industry

"This method of actualization of education, research and development, and regional development involves cooperation

within an employment sector to learn about authentic developments and problems encountered at work"; "The method systematically seeks answers to problems in which the solutions require new knowledge"; "The core of the model is formed by object-oriented work, meaning that learning focuses on genuine developments in working life"; "Learning has a clear objective and takes place through the process of generating new competences"; "Improvements in social skills and self-confidence are clear"; "More learning is needed to balance enthusiasm from new developers and their expertise with the managed goals of a legacy organization" [34], [39] and [40].

E. The Results of Inter-operative Learning

The evaluation report (2005) notes that LbD and Integrative Action empirically demonstrate a learning framework that includes co-instructing, co-operating and co-constructing, which can further extend students' collaborative work to cooperation within the Finnish innovation system [51]. Two underlined results of that evaluation are: "The learning environment is conceived broadly from the perspectives of the workplace, the region, a science university and even incipient internationalisation". This adds credibility to the future significance of pedagogical development work. In addition, the integrated pedagogical approach is based on student oriented activities and focuses on future workplace skills. Thus, it is an innovative but balanced approach for contributing entrepreneurial elements to education at universities of applied sciences, especially as the overall mission of universities of applied sciences is seen as consisting of practical operations that integrate the three tasks. It is a procedural and proactive model that integrates students' everyday activities with the development of the employment sector, which is based on working towards solving genuine problems. The model's theoretical foundations are solid and built on carefully considered analyses of the links in the operation [51]. The value based thinking of inter-operative learning is included in the value network model and proposed in [38].

F. The Results of Incipient Internationalization

Incipient internationalization (direct and indirect impacts): The notion of "an incipient internationalisation" [51] addresses international expertise services. It is a model and practice for integrating the three tasks and a strategy when using international partnerships to bring in expertise from other higher education institutions and similar labour market clusters around the world. This requires doing regional development tasks with international research-trainees and their networks in way that uses knowledge transformation to and from regions. Thus, part of the overall mission of universities of applied sciences is seen as consisting of practical operations that integrate the three tasks with international co-operation and networks. The target of the International Expertise Service is to develop a procedural and proactive practice that integrates students' everyday activities with the development of the international employment sector, which is based on working towards solving genuine problems and enabling the transformation of knowledge as well as competences in the global domain.

G. Results from Immaterial and Material Resources

The analysed strengths from the perspective of resources are that; co-operational and co-creative strategies are managed and actualized; an organization's learning occurs in the actualization process; vision is based on management and leadership culture and balances accountability and empowerment; the enforcement of international transformations of competences and applied research broadens research horizons; economic balance is improved due to the improved understanding and managing of cyclic and linear components of an economy; agility in action and culture is seen as possible and that influences, scopes and results are emphasized. The challenges are the pressure placed on management because the transformation to an LbD culture is difficult and requires ability and tolerance, and also because traditional lines of authority break due to the influence of the expertise culture. Also, the integrative system challenges the community of higher education institutions [50], [51] and [60].

H. Results of the Quality Management System

The quality process liberates entity and utility in Integrative Action, which means that quality is emphasized in results, impacts and processes but does not formalize innovations and inventions in advance or stop them from occurring. Quality in Integrative Action is seen from the perspective of improvements and confirmation and occurs in the self governance of an institution. It exists as a systematic way to promote institutions as learning organisations through confirmation as well as through comparison leading to improvements in action and processes. If quality ensures that each task in the process and actualization succeeds first time, this assumption liberates resources for cyclic and thematic innovation activities.

As a result the quality work of processes in the form of flow diagrams and process descriptions increases the understanding of quality by personnel and participants and it also has a place in the dialogue between organizations, innovation systems and the Ministry of Education. The most important result of quality management is that the personnel, participants and other actors in an organisation are committed to using the quality phases (plan-do-check/learn-act). It is important that teachers and actors are committed to the process guidelines of measuring, analysis and developments as well as the monitoring of processes. And that those activities are based on strategies and produce impacts and results that can be analyzed and verified. It also is crucial that practice is able to use the data that are going to be summarized into the quality system and that the data are meaningful to the development work so as to ensure their influence and that improvement can occur accordingly.

The benefits of affects and influences can be categorized into causal and mutual categories (similar to the Onion Model in [13]) and their influences occur as results, direct impacts or indirect impacts: all of which suggest that future work and more last mile research, living lab research and the research of impacts and influences are needed, as illustrated in Fig. 10.

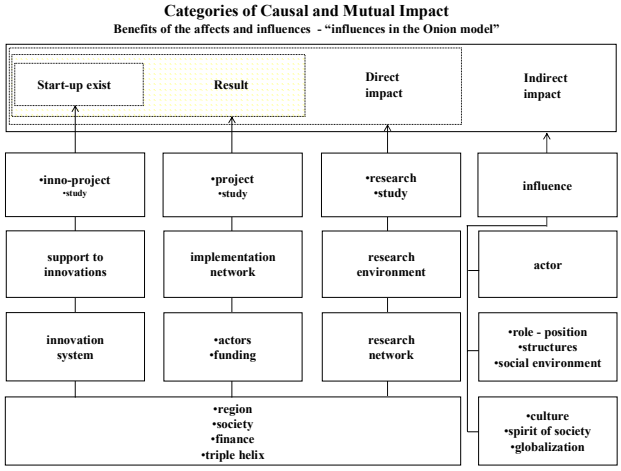

Fig. 10 shows that impacts and influences are causal and mutual. It also reveals that innovative results are possible to evaluate but demonstrates that formalizing and forcing ideas and innovations in advance is difficult.

IX. Conclusion and Discussion

LbD has been presented and evaluated as a functional, multi-disciplinary process and is seen as an innovative operating model based on authenticity, partnership, experiential learning, development and research [50], [51], [32], [35] and [60].

The information system research cases within LbD are often based on DR, Service Design [70] and [68], development [30] or living lab research [71]. The students are involved within authentic design and research. Thus, LbD requires students to undertake design projects rooted in the world of work while aiming to produce new designs, solutions and processes that require collaboration between teachers, students and workplace experts [71], [43], [44], [45] and [47]. Students' learning is focused on personal development to aid them in working life, provide research and social skills and the ability to produce new knowledge and competence about their environments and working practices [60], [36] and [34].

The term LbD is highly appropriate and descriptive. It combines the two main functions of universities of applied sciences. Professional education (learning) and teaching based on research (developing). The contribution of LbD is that research and authenticity is implemented and actualized into education.

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